Chemistry of Knowledge Elements: Elements of Knowledge as Elements In Nature

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Abstract— In this paper, we propose that knowledge can be reduced to its elementary (elemental) size consisting of quantized noun objects, their quantized verb functions, and the incremental type the convolutions that bind such noun objects and verb functions. Though knowledge may not be quantized as matter can be quantized in quantum sciences, it is possible to fragment knowledge finely enough to ask three basic elements; who does what, what is being done, and how is what being done. Such a bundle that answers these three questions makes up one knowledge element. These elements of knowledge (*kels*) exhibit statistical properties and their dynamics are be based on the properties of a large variety of *kels*, their origin, their environment, the media, and their recipients. Further, we define the elementary particles as a *kuantum* of knowledge, even though a *kuantum* is not a quantum in the traditional sense.

In maintaining a working relation with other sciences, we explore the flow of these *kels*. A quantum of knowledge (*kel*) is like a particle of matter or a pulse of energy. We present this concept to investigate if such *kels* will explain all the intricacies in the flow of knowledge in societies, cultures and groups. Even though a *kel* is not as defined precisely as quantum (an electron) in physics, but in the framework of theory presented here, the statistical properties of *kels* explains a statistical differences in the way in which noun objects communicate i.e., transmit and receive such *kuanta* and *kels*. This approach holds the maximum promise but the quantization of *a kel* to a workable size becomes unique and depends on the direction in which knowledge is being explored and/or constituted. The generic quantum of knowledge or *kel* still appears as a mystic entity, even though specific *kuanta* are feasible that the modern computers can tackle, build, process, constitute, reconstitute, reprocess to generate "artificial knowledge". Such artificial knowledge is then verified, validated and accepted or challenged, disputed and rejected by AI routines and by natural intelligence of human beings to build large and realistic *bodies of knowledge* (*bok's*) or knowledge centric objects (*kco's*) of any size, shape or form .

Index Terms—- Knowledge Flow, Artificial Knowledge, Kels, Kel-Flow, Utility of Knowledge , Kuanta of Knowledge , Kutility of Objects

I. INTRODUCTION

Knowledge and elements blend like wisdom and motivation in mind or like nouns and verbs mingle in the reality. Knowledge centric noun objects (*KCO*s) spread and flourish in societies like organisms in nature or like human beings in cultures. Such *KCO*s' relay knowledge elements (*kels)* in environment and culture thus forming a bond between self and society or between mind and culture. These

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kels traverse the social space between *KCO*s thus forming dialogs and interactions. In the domain of reality, the *kels* can be as tiny as microorganisms in biology or as enormous as cosmic objects in space. The atomic of these *kels* makes up the structure of information and knowledge as the nucleus of atoms that makes up the structure of matter. The ensuing information and knowledge binds societies and cultures like physical matter that binds reality.

The atomic structure of *kels* is as basic as the nuclear structure of elements. Noun objects, verb functions and their convolutions take the place of neutrons, protons and electrons. In their own unique stance, they carries very basic information about why, who, what, when, and how the *kels* exist and an underlying directions in which these *kels* can be useful, useless or hurtful to the society. The directionality of the utility of *kels* is thus established. A sense of good and bad is thus formed in the nuclear structure of *kels* like a sense of the potentially useful, useless or disruptive elements in nature. *KCO*s can indeed be human and machines and/or tools or conjectures.

The deployment of *kels* makes up the basis of all lives. Continued use of well-placed socially beneficent *kels* is the norm of civilized societies as much as the continued deployment of hurtful and destructive *kels* is the custom of Mafia, thugs, and the warmongers. The nature of *kels* and their innate structure renders their efficacy or their danger to the society in which they prevail. Much like elements and their compounds, *kels* and *kel*-chains can be poisonous or medicinal. In this paper, we develop a science, engineering, deployment of positively based knowledge elements, such as universities, schools, shrines, knowledge bases, etc., and to become aware about the potential abuse of negatively based *kels* such as terrorist groups, syndicates and violent political groups.

In order to be practical and to correlate with other disciplines, we explore the quantum theory of knowledge whereby the protocol for the knowledge paths between smallest knowledge centric objects (*kco*'s) and the larger knowledge centric objects (*KCO*'s) are transported. A continuum of noun objects (*no's*), verb functions (*vf's*), and the associated convolutions (*'s) is thus retained. This continuum is searched out by segmented knowledge machines that operate between the smaller *kco*'s and the larger *KCO*'s in any given domain or direction of knowledge. Dewey Decimal System (DDS) or the Library of Congress (LoC) classification offer two methodologies to classify the domain of knowledge pursued. One or more pathways exist in the chain of evolution of the subject matter and related inventions that have occurred around practical and real modules of knowledge in the range of any smaller *kco* to the larger *KCO*. All modalities of knowledge representation (images,

documents, graphs, presentations, etc.) need investigation to complete the pathway(s) between *kco*'s and *KCO*'s.

Minute constituents (i.e., *no's, *'s* and *vf's*) of *kels* can and do interact with the social and cultural character of the medium that carries them. In a very sense, the statistical properties of the medium alters the genesis, the transmission and the retention of these *kels* thus offering the vast varieties of lives, decay and death of knowledge in different societies and cultures. All the principles for the transmission of knowledge presented in Part B of this four part series of papers becomes applicable in this paper. Even though human beings may be daunted by such intricacy, knowledge machine can routinely handle tracking, transmission, attenuation and dispersion of knowledge in most societies.

II. Quantization of Knowledge

A. Basis from Human Physiology (KELs and Physiological Functions)

The human body offers an insight into how the body functions are knowledge based and how this knowledge is structured in a very functional format. A typical example of linkages between carbohydrate, fat and protein during metabolism is shown Figure 1. Additional amino acids and other organic compounds, CO_2, and various acids are produced and sometimes reabsorbed. The diagram shown is a simplified representation of how the chemistry of numerous elements functions together for illustrative purposes. Carbon, hydrogen and nitrogen especially play critical roles interdependently and in conjunction
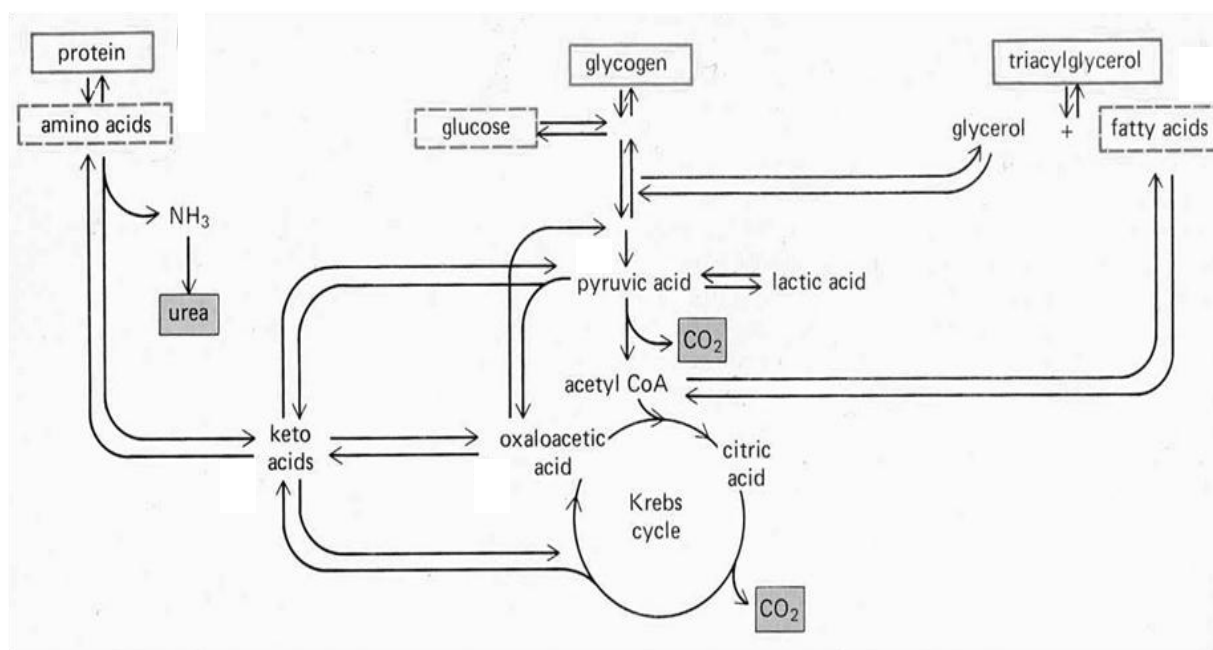

Figure 1. A simplified chain of noun objects (*no's*) linking carbohydrate, fat and protein metabolism with appropriate verb functions (*vf's*).

To draw a similarity between *kels* and the various components depicted in Figure 1, a more concise representation is shown in Figure 2a. Various compounds such as NH_3 or ammonia at metabolism 1, Kerbs cycle generating citric acid, and CO_2 at metabolism 2, reentering Kerbs cycle again 3 and 4, lactic acid at 4 should be considered as noun objects. The CO_2 at 4 are not shown to simplify the chain of metabolisms. Numerous types of metabolisms should be considered as verb function (*vf's*) in the body trigger the change of the status of these noun objects. Figure 2b depicts the more fundamental chain of noun objects that constitutes the human body.

B. Basis from Chemistry (Kels and Chemical Processes)

The diagrammatic representations of a *kel* and of a Carbon[1] atom are shown in Figures 2 and 3. Atoms of different elements are quantified by their corresponding atomic weights. The basic elements of knowledge, *kels* can exist in many "*kel* weights" (like atomic weights) depending

on the utility of the knowledge embedded in the *kel*. For instance, the atomic weight of the noble metals is much higher than that of the ordinary elements. The energy contained in their atoms is greater than that in the hydrogen atom with an atomic weight of 1.0078). The *kel*-weight of a brain surgeon (*no*) performing a (*vf*) transplant of the brain (if it is possible), in a very specific way (*) would be much higher than the *kel*-weight of a monkey (*no*) eating (*vf*) peanuts.

Other similarities exist. The atomic weights of all the elements are not the same and the *kel* weights of all knowledge elements can be as radically different as the atomic weights of gold and carbon. The very origins of *kels* determine their weights accordingly. A sense of economic values gets attached to *KELs* and the *kels* that have greater utility (drinking water vs. ocean water) and are also scarcity (gold vs. carbon) start to have higher *kel*-weights. Economics, utilitarian values and scarcity get intertwined at a conceptual and perceptual context in human minds. The human mind being far more perceptive than sciences, starts to weave a web of knowledge very precisely.

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[1] Carbon atom is chosen as an example, but any element that forms molecules and compounds exhibits similar properties and traits.
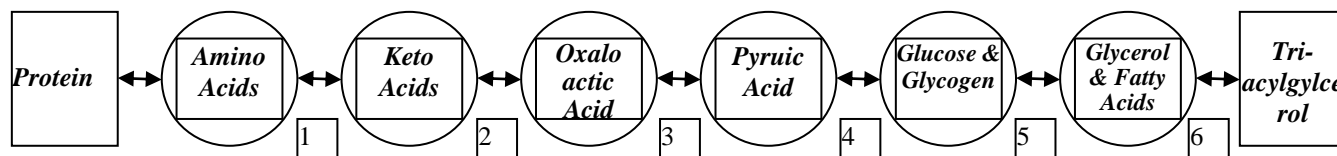
(a) A Simplified Chain of noun objects (*no's*) linking carbohydrate, fat and protein metabolism. Other noun objects (NH_3 or ammonia at metabolism 1), Kerbs cycle generating citric acid, and CO_2) at metabolism 2), reentering Kerbs cycle again 3 and 4, lactic acid at 4 and CO_2 at 4 are not shown to simplify the chain of metabolisms. Metabolisms should be considered as verb function (*vf's*) in the body the trigger the change of the status of noun objects. The processes are described in detail in most elementary books on human physiology.
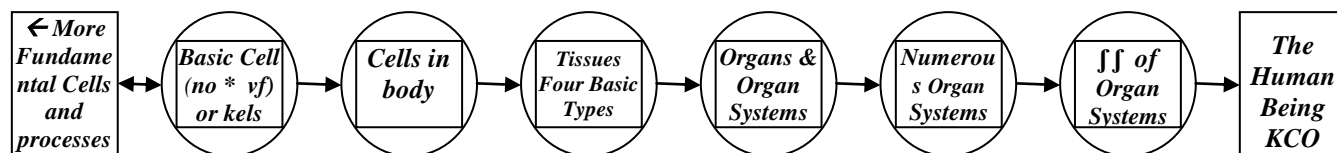
(b) Specific Example and Most Simplified Element Hierarchy to build a Most Complex *KCO* (e.g., a human being)

Figure 2. An continuous chain in the development for knowledge elements or *kels* that are like atoms, microbes, microorganisms, bacteria or even human beings that organize themselves to form the more complex chain of chemical compounds, life forms, organizations, societies and cultures. Knowledge get embedded in each of the stages of development to stabilize the particular element survive and then migrate to the next stage. Carbon element or any element has life cycle(s) of its own as a human being has event, developmental, life cycle and stage.
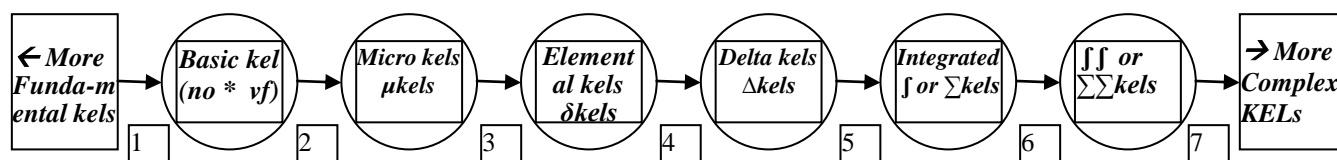

Figure 3. Generic Example of Knowledge Elements to make up An Integrated Knowledge Hierarchy of *KELs* and *KCOs*. Numerous other *kels* can be and are usually generated at the verb functions or *vf's* at transition points 1 through 7.

## III. MOLECULAR WEIGHTS OF CARBON COMPOUNDS AND LARGER KNOWLEDGE ELEMENTS

The behaviors of a Carbon atom and a *kel* are depicted in Figures 4 and 5. *Kels* can combine with themselves, (one or more) *kels*, and form chains of *kels* as in human dialogs where every step in the interactive process modifies the status of the present *kel*. *Kels* retain the history of modifications like a symbol in a series of steps of mathematical derivation or like a numeric symbol in computational processing. In a sense, like human objects, *kels* have a life of their own. Sometimes they live and die in the perception of human counterparts and sometime they as real as sentences and procedures documented in textbooks.

The variety of *kels* can be as large as the number of molecules and compounds in the real world. *Kels* can be as transitory as the fleeting passion or as (semi-) permanent as the written word. In most cases, *kels* have a utilitarian value. This utilitarian value is indicative of the *kel*-weight. The utility if a *kel* depends on the need that it gratifies for a individual or in a society. Thus, a *kel* to represent a monkey eating peanuts would fall well below the *kel* as a programmer developing new software. In the mathematical domain, *kels* exist and thrive. The knowledge content of a *kel* written as ($E = mc^2$) would have a greater utilitarian value written as a *kel* written as (d = ½ at^2) because of the differences in nature and implication in the real world. Likewise, humans also carry their own personalized *kel*-weights as do machines and gadgets. Intelligence adds an addition convolution in the computation of *kel*-weights as explored in Section IV.

A. Atomic Weights of Elements and Kel Weights

Atomic weight consists of three weights, weights of the protons, neutrons and electrons. Thus the heavy metals have a more complex atomic structure than the higher metals. Similarly, complex compounds can be substantially heavier than simple molecules. For example, the atomic structure of a Gold atom (atomic weight of 197) has 79 Protons, 118 neutron and 112 electrons in 7 Electron shells. The molecular weights of compounds also exhibit similar characteristics. In Figure 7, the Carbon atom and its molecules are used to indicate the chain of compounds derived from Carbon atoms on the left side. Carbon atoms combine with other elements, and metals to form elaborate arrays of compounds. The alkane chain is used to depict the molecular weights on the right side. The molecular weights in g/mol increase as the chain of hydrocarbons becomes longer in column 2 and the energy contained expressed as in kJ/mol also increases. As seen in the Sections B and C, and depicted in Figure 8, *kels* and *kco's* also exhibit similar properties.
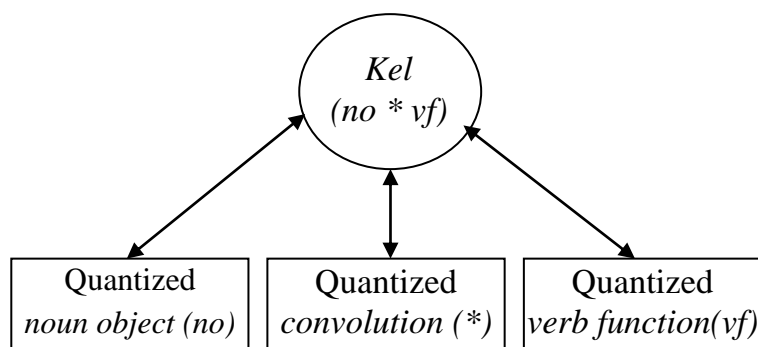
Structure of a *kel* constituted as the knowledge when a noun object *no* convolves (*) with a verb function *vf* in a specific convolution * format.
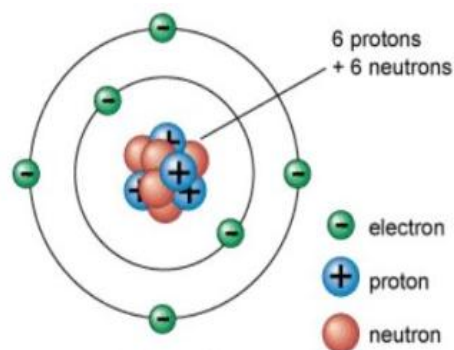
The Structure of a Carbon Atom

Figure 4. The basic *kels* in Figure 4 are comparable to atom made up of electrons, protons and neturons. The basic building blocks or *kels* can be shared and enhanced to form other knowledge elements. As much as the structure of atoms is altered in chemical reactions, the structure of knowledge is altered, modified, truncated or even eleminated by actions, words or dealings in human environments.

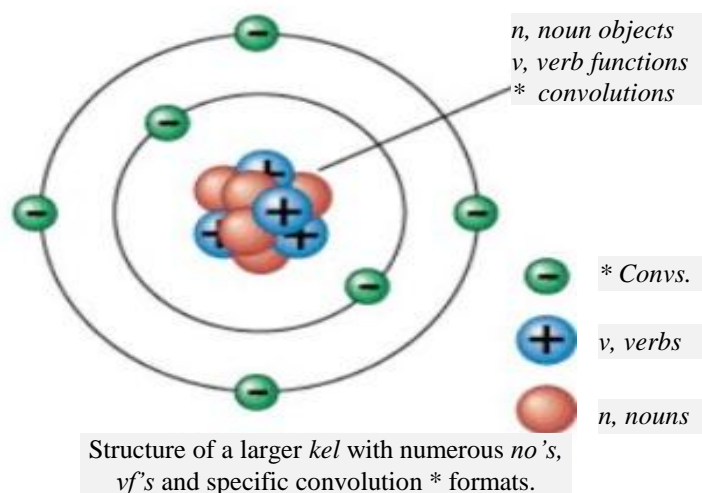Structure of a larger *kel* with numerous *no's, vf's* and specific convolution * formats.

Figure 5. The basic *kels* in Figure 4 are comparable to atom made up of electrons, protons and neturons. The basic building blocks or *kels* can be shared and enhanced to form other knowledge elements. As much as the structure of atoms is altered in chemical reactions, the structure of knowledge is altered, modified

B. Molecular Weights of Chemical Compounds

Molecular weights of compounds are based on the corresponding atomic weight of the constituting elements and have a definite measure since the atomic weight are known and periodic tables exist. Unfortunately, we do nor have similar measures in the knowledge domain. However, the noun objects have a history of the knowledge trail behind them which specifies how much energy has been spent in acquiring the knowledge in the particular *KCO*. In a sense, the higher molecular weight compound (such as Heptane, see Table I) will have a gross energy of ≈ 4824 KJ/mol compared to Methane that has 889 KJ/mol. When deployed, the released energy is corresponding high for Heptane.

C. Molecular Weights of Chemical Compounds

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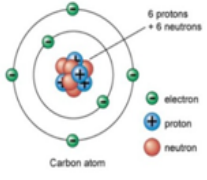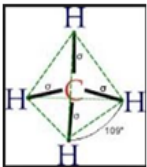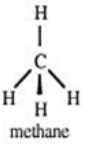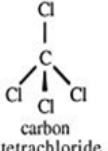
The Behavior of a Carbon Atom in Interaction with Hydrogen Atoms to form various Compounds				
(i) A Carbon Atom with a bond angle of 109.5°	(ii) Methane	(iii) CH_4, CCl_4 and C_2H_6 Structures,	(iv) With tetrahedral bond angle of 109.5°	(v) A Branded a chain (Alkane)

Figure 6. The Alkane (C_nH_{2n+2}) Family (Methane, Ethane, Propane, Butane, Pentane, Hexane, etc.) and the adaptive role of the Carbon Atom (C).

Table I Molecular Weight and Gross Energy of Some Basic Carbon Compounds

Carbon Compounds	Molecular Weight [x]	Gross Energy [э] =kJ/mol
HCHO	30.03 g/mol	Formaldehyde (NA)
NH2CH2COOH	75.07 g/mol	Glycine (NA)
C6H5CHO	106.12 g/mol	Benzaldehyde (NA)
C2HCl3OH2O	165.40 g/mol	Chloral Hydrate (NA)
C19H29COOH	302.45 g/mol	Abietic Acid (NA)
C21H20BrN3	394.31 g/mol	Ethidium Bromide (NA)
Methane, CH_4	16.04 g/mol	889
Ethane, C_2H_6	30.07 g/mol	1560
Propane, C_3H_8	44.16 g/mol	2220
Butane, C_4H_{10}	58.12 g/mol	2877
Pentane, C_5H_{12}	72.15 g/mol	3507
Heptane, C_7H_{16}	100.20 g/mol	≈ 4824

Notes: [x] The numbers are approximate, since the atomic weight of H is 1.00789 and the standard atomic weight of C is 12.011. NA indicates that the number is not available.
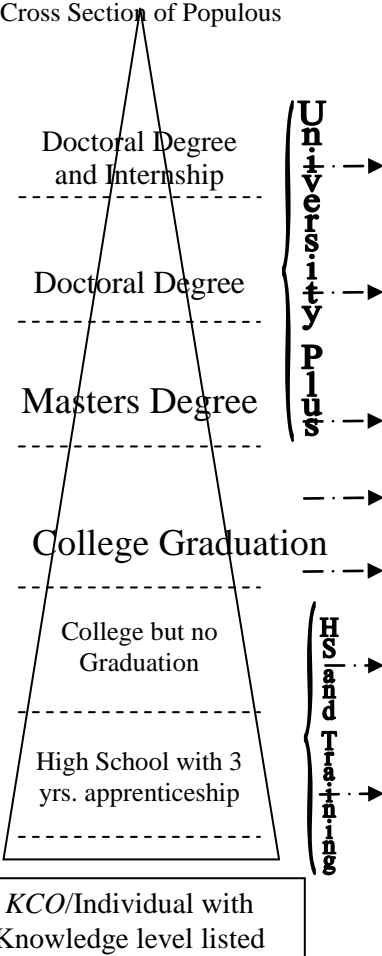
[э] The quantity known as higher heating value (**HHV[2]**) (or gross energy or upper heating value or gross calorific value (**GCV**) or higher calorific value (**HCV[3]**)). It can also be expressed as MJ/kg.

Figure 7. The properties the carbon atom as it forms compounds with other elements, H, O, N, etc

[2]   is determined by bringing all the products of combustion back to the original pre-combustion temperature, and in particular condensing any vapor produced. Such measurements often use a standard temperature of 25 °C (77 °F). This is the same as the thermodynamic heat of combustion since the enthalpy change for the reaction assumes a common temperature of the compounds before and after combustion, in which case the water produced by combustion is liquid.

[3]   The higher heating value takes into account the latent heat of vaporization of water in the combustion products, and is useful in calculating heating values for fuels where condensation of the reaction products is practical (e.g., in a gas-fired boiler used for space heat). In other words, HHV assumes all the water component is in liquid state at the end of combustion (in product of combustion) and that heat below 150 °C can be put to use.

Table II Comparative Knowledge Utilities of Individuals with Different Levels of Education and Training

Cross Section of Populous

Doctoral Degree and Internship

Doctoral Degree

Masters Degree

College Graduation

College but no Graduation

High School with 3 yrs. apprenticeship

KCO/Individual with Knowledge level listed

Integrated Knowledge/ Education in Skill	Social Need for the particular Skill Skill Factor = (SNF_i)	Utilitarian Value of Knowledge or "*KEL* Utility Weights"/Year	Lifetime Social Utility of Knowledge
Computed to be in range of (400 to 1200) °K Averaged at 800 °K Ref. [1]	Skills *l,m.n, …* etc. for Interns	(800 times $SNF_{l,m,or\ n}$) kutils/yr.	40,000 $SNF_{l,m,n}$ Kutils, Work expectancy $\approx$ 50 Yrs
Computed [ ]to be in range of (260 to 1000) °K Averaged at 630 °K Ref. [1]	Skills *l,m.n, …* etc. for PhD's	(630 times $SNF_{l,m,or\ n}$) kutils/yr.	31,500 $SNF_{l,m,n}$ Kutils, Work expectancy $\approx$ 50 Yrs
Computed to be in range of (200 to 240) °K Averaged at 220 °K Ref. [1]	Skills *l,m.n, …* etc. for MS/MA Degree holders	(240 times $SNF_{l,m,or\ n}$) kutils/yr.	12,100 $SNF_{l,m,n}$ Kutils, Work expectancy $\approx$ 50 - 60 Yrs
Computed to be in range of (100 to 160) °K Averaged at 130 °K or less Ref. [1]	Skills *l,m.n, …* etc. for BS/BA Degree holders	(130 times $SNF_{l,m,or\ n}$) kutils/yr.	7,800 $SNF_{l,m,n}$ Kutils, Work expectancy $\approx$ 60 Yrs
Computed to be in range of (50 to 110) °K Averaged at 80 °K Ref. [1]	Skills *l,m.n, …* etc. for < BS/BA Degree holders	(80 times $SNF_{l,m,or\ n}$) kutils/yr.	6,400 $SNF_{l,m,n}$ Kutils, Work expectancy $\approx$ 60 Yrs
Computed to be in range of (50 to 100) °K Averaged at 75 °K Ref. [1]	Skills *l,m.n, …* etc. for HS Diploma holders	(75 times $SNF_{l,m,or\ n}$) kutils/yr.	4,500 $SNF_{l,m,n}$ Kutils, Work expectancy $\approx$ 60 Yrs

The similarity between *kels* and chemical elements should be explored and investigated with due caution. In chemistry, elements form the basis of compounds and compound chains. In knowledge science, *kels* make up for the generation of new *kels* and are themselves derived from other *kels*. Long residence of *kels* in human can alter the personality of humans who become *KELs* themselves such as large populations and concentration of physics *kels* in a scientist can make him a physicist and a knowledge element *KEL*. This type of a phenomenon is generally not perceived in elements, though it is present. For instance, a large collection of gold atoms in an object is a gold-*kel*. However, elements in complex chains of other derived molecules will alter their behavior to suit the chemical reaction. Energy is thus exchanged, received or generated. Human, *KELs* may perform in a similar fashion but the methodology is not documented nor formulized.

When the commonalities are completely standardized and formulized, they will create barrier to human creativity, inventions and innovations since a human being is robbed of the freedom to explore new solutions. Every activity will be catalogued and the outcome will be predictable. In a sense, even chemical elements behave with a certain amount of randomness as new compounds and drugs are being synthesized and developed but this methodology is more streamlined in chemistry rather than in social sciences.

Social dynamics is more rapid and major cultural changes can accrue faster than the changes in the chemistry of elements, even though no element is indefinitely stable in a cosmic timeframe.

IV. POTENTIAL AND UTILITY OF KNOWLEDGE, KELS AND KCO'S

In the knowledge domain, *KCO*s with a high level of knowledge acquired during their preceding knowledge trail, have a larger "knowledge weight" or a larger knowledge potential [1] or *KnP* to perform more elaborate, more skilled, more intense verb functions. For example, the services of a doctor and those of a nonprofessional will have their own differences. This statement implies that a highly educated individual can and usually performs more socially desirable tasks in their own professions. The utility of knowledge thus gained or the knowledge potential thus acquired is indicative of the utility of the *KCO* (or an individual) that has such knowledge. The molecular weight and the knowledge weight thus retain their equivalency but with on radical difference.

Whereas the energy in the chemical compounds get exhausted after its use, the knowledge potential is not depleted and generally enhanced and regenerated (in many cases) by being used in a creative direction. This is a fundamental difference between knowledge in life forms and

energy in inanimate objects. Creativity and regeneration is the key to being alive.

A. Knowledge Utility (Kutility) of Life Forms

Kutility is defined as the utility of knowledge for knowledge centric object or a human being with history of knowledge acquisition or skill. When used appropriately, this training offers a measurable utility for the public and the society and thus enhances values and morality. Conversely, in an abusive mode, this abuse of knowledge like that of power can bring wars, hate and disasters to the society and bring negative features to a sane society. Unfortunately, deceit can also grow exponentially. For example, while Internet is being used to promote Russian brides and Asian singles, the values of a society can only degenerate by associating cheap sex with the security and sanctity of lifelong matrimony.

B. Non-Depletion and Self Regeneration of Knowledge

When learning is practiced in the traditional and positive sense, retention of knowledge follows by comprehension and its expected utility for future use. Knowledge retains its value more intensely than the value of other materialistic assets in most cases. The deployment of knowledge does NOT deplete it; instead a life form that contains knowledge nurtures it like the womb nurtures the seminal XX or XY chromosome pair. Growth nurtures growth exponentially and new imprint of knowledge evolves. Constant learning to be polished in the latest novelties and technologies in any profession does not deplete knowledge but invigorates a methodology to weigh and consider the latest information in view or in conjunction of the prior knowledge. Structure, order and connectivity result. The process yields an exponential understanding of the professional subject matter and an enhanced positive use of such newly generated knowledge.

C. Kutility of Acquired Knowledge

A table similar to Table I can be constructed for *KCO*s with various histories of knowledge trails. The energy is not depleted but continuously regenerated by life giving forces in the animate objects. The term utility is used in this context but has a broader implication than the traditional utility used by economists in economic analysis. Hence, the term utility has a time dimension associated with it since time is limited for all life forms and any *KCO* can deploy the "knowledge weight" for so many hours a day, a, week, or a year, or even over the lifetime of a particular *KCO*. Table II illustrated the "*KEL* utility weights" of typical individuals with training from High School Diplomas, through to post doctoral internships is presented in Table II.

V. CONCLUSIONS

This paper offers specific means of quantifying the knowledge and the potential gained by formalized education in any society. Animate and chemical parallelisms are used to evolve the basic element of knowledge defined in this paper as a *kel* to specify a *k*nowledge *el*ement. Exchange of such *kels* makes and breaks social bondage and interdependencies between small and large knowledge centric objects. The level of exchange of *kels* is also quantified as the integrated work or energy in the knowledge trail behind humans and machines. Whereas humans learn and retain knowledge learned in their minds, machines carry the embedded intelligence in the silicon chips and the firmware and software code that control CPU functions.

The utilitarian value of different knowledge centric objects is computed as the projected weight of the knowledge-based *kels* learned, retained and deployed by individuals in the social and cultural environments and by the machines in network and robotic environments. Quantitative estimations and prediction can thus be made on a scientific methodology. The results presented in the paper reaffirm the observed results in real life; however, a firm quantitative basis is introduced in the analysis and prediction of knowledge and the gross knowledge-utility of humans, robots and machines. Such quantitative methods in chemistry have been the basis of the Periodic Tables used extensively throughout the discipline of chemical analysis.

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